REMARKS/ARGUMENT

This Preliminary Amendment is being submitted to change the multiple dependent claims to single dependent claims in order to reduce the government filing fee.

EXPRESS MAIL CERTIFICATE

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Name of Person Mailing Correspondence

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Signature

July 6, 2001

Date of Signature

Respectfully submitted,

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APPENDIX A

"CLEAN" VERSION OF EACH PARAGRAPH/SECTION/CLAIM

37 C.F.R. § 1.121(b)(ii) AND (c)(i)

CLAIMS ~~(with indication of amended or new):~~

(Amended) 4. An optical-spectrum flattening method according to claim 1, characterized in that:

A1

during said second step, a modulator is used which modulates an amplitude or phase of a temporal waveform composed of said discrete optical spectrum.

(Amended) 19. A multi-wavelength generating apparatus according to claim 16, characterized in that:

said modulating section linearly modulates the phase of the incident light of the single wavelength relative to a single voltage waveform applied to said input ports of said optical modulating means,

said predetermined period is composed of an increase period corresponding to a half continuous period of said signal voltage and in which the signal voltage increases monotonously and a decrease period corresponding to the remaining half continuous period and in which the signal voltage decreases monotonously in a manner such that the monotonous increase and decrease are symmetrical, and

A2 cont

said amplitude modulator gates said signal voltage waveform individually during said increase period and during said decrease period.

(Amended) 20. A multi-wavelength generating apparatus according to claim 16, characterized in that:

said modulating section linearly modulates that phase of the incident light of the single wavelength relative to a signal voltage waveform applied to said input port of said optical modulating means,

said predetermined period is composed of an increase period corresponding to a half continuous period of said signal voltage and in which the signal voltage increases monotonously and a decrease period and in which the signal voltage decreases monotonously in a manner such that the monotonous increase and decrease are symmetrical, and

said amplitude modulator gates said signal voltage waveform with predetermined timings that span across said increase period and said decrease period.

(Amended) 21. A multi-wavelength generating apparatus according to claim 13, characterized in that:

A2 concld

said plurality of optical paths inside said modulator further have a plurality of optical paths coupled together in parallel, said optical modulating means are arranged in at least one of said plurality of parallel optical paths, and said plurality of optical paths cooperate in performing an amplitude modulating operation.

(Amended) 24. A multi-wavelength generating apparatus according to claim 13, characterized in that:

said optical modulating means are EL (Electro-Absorption) intensity modulators.

(Amended) 25. A multi-wavelength generating apparatus according to claim 13, characterized by further comprising bias means for applying a bias to said modulating means while independently varying a power thereof.

(Amended) 26. A multi-wavelength generating apparatus according to claim 13, characterized in that:

A3 cont

said modulating section comprises two optical modulating means including an amplitude modulator and a phase modulator.

(Amended) 27. A multi-wavelength generating apparatus according to claim 13, characterized by further comprising means for multiplying said signal voltage of the predetermined period, and in that:

at least one of said plurality of voltage applying means regulates said multiplied signal voltage and the regulated voltage is then applied to said modulating section.

(Amended) 28. A multi-wavelength generating apparatus according to claim 13, characterized by further comprising signal generating means for generating said signal voltage of the predetermined period as a sinusoidal wave.

(Amended) 29. A multi-wavelength generating apparatus according to claim 13, characterized in that:

said optical modulating means are all optical phase modulators,

said sinusoidal signal voltages are each regulated so that a sum thereof is substantially 1.0π or 1.4π in terms of a phase modulation index.

A3 concld

(Amended) 30. A multi-wavelength generating apparatus according to claim 13, characterized by further comprising signal generating means for generating signal voltage of the predetermined period as a predetermined temporal waveform signal.

(Amended) 31. A multi-wavelength generating apparatus according to claim 13, characterized in that:

phase adjusting means for adjusting temporal positions of said independently regulated signal voltages is provided in one of said plurality of voltage applying means.

A4

(Amended) 35. A multi-wavelength generating apparatus according to claim 13, characterized by further comprising multiplexing means for multiplexing a plurality of incident lights of different single central wavelengths and allowing said multiplexed light to fall on a first optical modulating means of said modulating section.

(Amended) 40. A coherent multi-wavelength signal generating apparatus according to claim 38, characterized in that:

A5 cont

when a band of a receiver is defined as Be[Hz], a demultiplexing band of a demultiplexer located before the receiver is defined as B_0[Hz], a signal mark rate is defined as M, a signal light intensity of an output from an i-th modulator is defined as P(i) [dBm], an intensity of a stimulated emission light in the output from this modulator is defined as Pc(i) [dBm], an intensity of a spontaneous emission light in the output from this modulator is defined as Ps(i) [dBm], an equivalent current flowing through said receiver is defined as Ieq[A], shot noise in signal components is defined as Ns, beat noise between the signal components and a spontaneous emission light is defined as Ns-sp, beat noise between spontaneous emission lights is defined as Nsp-sp, and thermal noise from said receiver is defined as N_{th}, said control means controls the shape of the spectrum of the multi-wavelength light output from said multi-wavelength light

source so that a signal-to-noise ratio SNR for outputs from said modulators meets the following equations:

$$SNR = S/(Ns+Ns\text{-}sp+Nsp\text{-}sp+N_{th})$$

$$Ps(i) = RIN(i)+10\log_{10}Be+Pc(i)+10\log_{10}M$$

$$S = ((e\eta/h\nu)Pc(i))^2$$

$$Ns = 2e((e\eta/h\nu)P(i))Be$$

$$Ns\text{-}sp = 4(e\eta/h\nu)^2Pc(i)Ps(i)Be/Bo$$

$$N_{th} = Ieq^2Be$$

where P(i), Pc(i), and Ps(i) in S, Ns, and Ns-sp are expressed in W using a linear notation.

(Amended) 41. A coherent multi-wavelength signal generating apparatus according to claim 38, characterized in that:

when a band of a receiver is defined as Be[Hz], a demultiplexing band of a demultiplexer located before the receiver is defined as B_0[Hz], a signal mark rate is defined as M, a signal light intensity of an output from an i-th modulator is defined as P(i) [dBm], [a] <u>an</u> intensity of a stimulated emission light in the output from this modulator is defined as Pc(i) [dBm], an intensity of a spontaneous emission light in the output from this modulator is defined as Ps(i) [dBm], an equivalent current flowing through the receiver is defined as Ieq[A], a rate of leakage from a j-th port to an i-th port of said multiplexer is defined as XT(i), a light intensity of a cross talk signal from said multiplexer is defined as Px(i) [dBm], shot noise in signal components is defined as Ns, beat noise between the signal components and the spontaneous emission light is defined as Ns-sp, beat noise between the signal components and the cross talk signal light is defined as Ns-x, beat noise between spontaneous emission lights is defined as Nsp-sp, beat noise between the cross talk signal light and the spontaneous emission light is defined as Nx-sp, and thermal noise from said receiver is defined as N_{th};

said control means controls the shape of the spectrum of the multi-wavelength light source so that a signal-to-noise ratio SNR for outputs from said modulators meets that following equations:

$$SNR = S/(Ns+Ns\text{-}sp+Nx\text{-}sp+Nsp\text{-}sp+Ns\text{-}x+N_{th})$$

$$Ps(i) = RIN(i)+10\log_{10}Be+Pc(i)10\log_{10}M$$

$$Px(i) = \Sigma P(j)\bullet XT(j)$$

$$S = ((e\eta/h\nu)Pc(i))^2$$

$$Ns = 2e((e\eta/h\nu)P(i))Be$$

$$Ns\text{-}sp = 4(e\eta/h\nu)^2Pc(i)Ps(i)Be/Bo$$

$$Nx\text{-}sp = 4(e\eta/h\nu)^2Px(i)Ps(i)Be/Bo$$

$$Ns\text{-}x = (e\eta/h\nu)^2Pc(i)Px(i)$$

$$N_{th} = Ieq^2Be$$

A5 Concld.

where P(i), Pc(i), and Ps(i) in S, Ns, and Ns-sp are expressed in W using a linear notation.

(Amended) 42. A coherent multi-wavelength signal generating apparatus according to claim 38, characterized in that:

said multi-wavelength light source comprises a light source for generating a light having a single central wavelength and an optical modulator for modulating an intensity or phase of an output light from the light source using a predetermined period signal, to generate a multi-wavelength light, and

said control means regulates at least one of a voltage of said period signal and a bias voltage at said optical modulator so as to control a shape of an optical spectrum of the multi-wavelength light generated by said multi-wavelength light source.

(Amended) 48. A multi-wavelength light according to claim 45, characterized in that:

A6

said first and second modulating means/said modulating means executes such modulations that side modes are output so that the optical powers of output wavelengths at outputs of said polarization multiplexing means/said modulating means are substantially equal.

APPENDIX B

VERSION WITH MARKINGS TO SHOW CHANGES MADE
37 C.F.R. § 1.121(b)(iii) AND (c)(ii)

CLAIMS:

4. An optical-spectrum flattening method according to [any of claims 1 to 3] claim 1, characterized in that:

during said second step, a modulator is used which modulates an amplitude or phase of a temporal waveform composed of said discrete optical spectrum.

19. A multi-wavelength generating apparatus according to claim 16 [or 18], characterized in that:

said modulating section linearly modulates the phase of the incident light of the single wavelength relative to a single voltage waveform applied to said input ports of said optical modulating means,

said predetermined period is composed of an increase period corresponding to a half continuous period of said signal voltage and in which the signal voltage increases monotonously and a decrease period corresponding to the remaining half continuous period and in which the signal voltage decreases monotonously in a manner such that the monotonous increase and decrease are symmetrical, and

said amplitude modulator gates said signal voltage waveform individually during said increase period and during said decrease period.

20. A multi-wavelength generating apparatus according to claim 16 [or 18], characterized in that:

said modulating section linearly modulates that phase of the incident light of the single wavelength relative to a signal voltage waveform applied to said input port of said optical modulating means,

said predetermined period is composed of an increase period corresponding to a half continuous period of said signal voltage and in which the signal voltage increases monotonously and a decrease period and in which the signal voltage decreases monotonously in a manner such that the monotonous increase and decrease are symmetrical, and

said amplitude modulator gates said signal voltage waveform with predetermined timings that span across said increase period and said decrease period.

21. A multi-wavelength generating apparatus according to [any of claims 13 to 18] claim 13, characterized in that:

said plurality of optical paths inside said modulator further have a plurality of optical paths coupled together in parallel, said optical modulating means are arranged in at least one of said plurality of parallel optical paths, and said plurality of optical paths cooperate in performing an amplitude modulating operation.

24. A multi-wavelength generating apparatus according to [any of claims 13 to 18] claim 13, characterized in that:

said optical modulating means are EL (Electro-Absorption) intensity modulators.

25. A multi-wavelength generating apparatus according to [any of claims 13 to 18] claim 13, characterized by further comprising bias means for applying a bias to said modulating means while independently varying a power thereof.

26. A multi-wavelength generating apparatus according to [any of claims 13 to 18] claim 13, characterized in that:

said modulating section comprises two optical modulating means including an amplitude modulator and a phase modulator.

27. A multi-wavelength generating apparatus according to [any of claims 13 to 18] claim 13, characterized by further comprising means for multiplying said signal voltage of the predetermined period, and in that:

at least one of said plurality of voltage applying means regulates said multiplied signal voltage and the regulated voltage is then applied to said modulating section.

28. A multi-wavelength generating apparatus according to [any of claims 13 to 18] claim 13, characterized by further comprising signal generating means for generating said signal voltage of the predetermined period as a sinusoidal wave.

29. A multi-wavelength generating apparatus according to [any of claims 13 and 14] claim 13, characterized in that:

said optical modulating means are all optical phase modulators,

said sinusoidal signal voltages are each regulated so that a sum thereof is substantially 1.0π or 1.4π in terms of a phase modulation index.

30. A multi-wavelength generating apparatus according to [any of claims 13 to 18] claim 13, characterized by further comprising signal generating means for generating signal voltage of the predetermined period as a predetermined temporal waveform signal.

31. A multi-wavelength generating apparatus according to [any of claims 13 to 18] claim 13, characterized in that:

phase adjusting means for adjusting temporal positions of said independently regulated signal voltages is provided in one of said plurality of voltage applying means.

35. A multi-wavelength generating apparatus according to [any of claims 13 to 18] claim 13, characterized by further comprising multiplexing means for multiplexing a plurality of incident lights of different single central wavelengths and allowing said multiplexed light to fall on a first optical modulating means of said modulating section.

40. A coherent multi-wavelength signal generating apparatus according to claim 38 [or 39], characterized in that:

when a band of a receiver is defined as Be[Hz], a demultiplexing band of a demultiplexer located before the receiver is defined as B_0[Hz], a signal mark rate is defined as M, a signal light intensity of an output from an i-th modulator is defined as P(i) [dBm], an intensity of a stimulated emission light in the output from this modulator is defined as Pc(i) [dBm], an intensity of a spontaneous emission light in the output from this modulator is defined as Ps(i) [dBm], an equivalent current flowing through said receiver is defined as Ieq[A], shot noise in signal components is defined as Ns, beat noise between the signal components and a spontaneous emission light is defined as Ns-sp, beat noise between spontaneous emission lights is defined as Nsp-sp, and thermal noise from said receiver is defined as N_{th}, said control means controls the shape of the spectrum of the multi-wavelength light output from said multi-wavelength light

source so that a signal-to-noise ratio SNR for outputs from said modulators meets the following equations:

$$SNR = S/(Ns+Ns\text{-}sp+Nsp\text{-}sp+N_{th})$$

$$Ps(i) = RIN(i)+10\log_{10}Be+Pc(i)+10\log_{10}M$$

$$S = ((e\eta/h\nu)Pc(i))^2$$

$$Ns = 2e((e\eta/h\nu)P(i))Be$$

$$Ns\text{-}sp = 4(e\eta/h\nu)^2Pc(i)Ps(i)Be/Bo$$

$$N_{th} = Ieq^2Be$$

where P(i), Pc(i), and Ps(i) in S, Ns, and Ns-sp are expressed in W using a linear notation.

41. A coherent multi-wavelength signal generating apparatus according to claim 38 [or 39], characterized in that:

when a band of a receiver is defined as Be[Hz], a demultiplexing band of a demultiplexer located before the receiver is defined as B_0[Hz], a signal mark rate is defined as M, a signal light intensity of an output from an i-th modulator is defined as P(i) [dBm], [a] <u>an</u> intensity of a stimulated emission light in the output from this modulator is defined as Pc(i) [dBm], an intensity of a spontaneous emission light in the output from this modulator is defined as Ps(i) [dBm], an equivalent current flowing through the receiver is defined as Ieq[A], a rate of leakage from a j-th port to an i-th port of said multiplexer is defined as XT(i), a light intensity of a cross talk signal from said multiplexer is defined as Px(i) [dBm], shot noise in signal components is defined as Ns, beat noise between the signal components and the spontaneous emission light is defined as Ns-sp, beat noise between the signal components and the cross talk signal light is defined as Ns-x, beat noise between spontaneous emission lights is defined as Nsp-sp, beat noise between the cross talk signal light and the spontaneous emission light is defined as Nx-sp, and thermal noise from said receiver is defined as N_{th};

said control means controls the shape of the spectrum of the multi-wavelength light source so that a signal-to-noise ratio SNR for outputs from said modulators meets that following equations:

$$SNR = S/(Ns + Ns\text{-}sp + Nx\text{-}sp + Nsp\text{-}sp + Ns\text{-}x + N_{th})$$

$$Ps(i) = RIN(i) + 10\log_{10}Be + Pc(i)\,10\log_{10}M$$

$$Px(i) = \Sigma P(j) \bullet XT(j)$$

$$S = ((e\eta/h\nu)Pc(i))^2$$

$$Ns = 2e((e\eta/h\nu)P(i))Be$$

$$Ns\text{-}sp = 4(e\eta/h\nu)^2 Pc(i)Ps(i)Be/Bo$$

$$Nx\text{-}sp = 4(e\eta/h\nu)^2 Px(i)Ps(i)Be/Bo$$

$$Ns\text{-}x = (e\eta/h\nu)^2 Pc(i)Px(i)$$

$$N_{th} = Ieq^2 Be$$

where P(i), Pc(i), and Ps(i) in S, Ns, and Ns-sp are expressed in W using a linear notation.

42. A coherent multi-wavelength signal generating apparatus according to claim 38 [or 39], characterized in that:

said multi-wavelength light source comprises a light source for generating a light having a single central wavelength and an optical modulator for modulating an intensity or phase of an output light from the light source using a predetermined period signal, to generate a multi-wavelength light, and

said control means regulates at least one of a voltage of said period signal and a bias voltage at said optical modulator so as to control a shape of an optical spectrum of the multi-wavelength light generated by said multi-wavelength light source.

48. A multi-wavelength light according to claim 45 [or 47], characterized in that:

said first and second modulating means/said modulating means executes such modulations that side modes are output so that the optical powers of output wavelengths at outputs of said polarization multiplexing means/said modulating means are substantially equal.